Remarks

Claims 1-17 are pending herein. By this Amendment, the specification, Abstract and 1, 3-5 and 9-17 have been amended to correct minor informalities. Claims 10, 12-14, 16 and 17 have been further amended to depend from or refer to claim 9 rather than claim 8.

In the Office Action, claims 1-17 are rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,265,484 to Trepka et al. ("Trepka").

In view of the amendments and remarks herein, Applicants respectfully request reconsideration and withdrawal of the rejection set forth in the Office Action.

I. The Rejection

Claims 1-17 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Trepka.

Trepka is cited for disclosing a process for producing resinous tapered block copolymers of vinyl-substituted aromatic hydrocarbons and conjugated dienes. The Trepka process includes the steps of: (a) charging a monovinylaromatic monomer and an initiator in the presence of a randomnized and allowing polymerization until essentially no free monomer is present; (b) charging an initiator and a monovinylaromatic monomer and allowing polymerization until essentially no free monomer is present; and (c) charging a mixture of monovinylaromatic monomer and conjugated diene monomer and allowing polymerization until essentially no free monomer is present (col. 2, lines 20-40). According to the Office Action, randomizers are the same as polar compounds for the present claim 2, col. 3, lines 39-40. Trepka is further cited for disclosing a living polymerization process using an initiator such as organomonoalkali metal compound of the formula RM, col. 3, line 13, for the present claim 3. The polymerization is carried out in a hydrocarbon diluent in an absence of oxygen and water (col. 8, lines 22-23, and col. 9, lines 65-66). The living polymer is terminated with an active compound such as water or alcohol to remove any remaining alkali metal from the copolymer chain (col. 10, lines 43-46). Thus, the copolymer is recovered using a terminating agent. The polymerization process can include one or more difunctional or polyfunctional coupling agents (col. 10, lines 6-22), for the present claim 12.

According to the Office Action, the difference between the instant claims and Trepka is the requirement in the present claims that in the second step (b) a conjugated diene monomer is charged to the system of product from step (a). The Office Action notes that Trepka does not disclose exactly the same subsequent charge of particular monomer.

According to the Examiner, it would have been obvious to modify the order of adding monomers in a method for preparing a tapered block copolymer in Trepka's invention such that a conjugated diene monomer is added in the second step to the system instead of a monovinylaromatic monomer for making the same sequence charging of the particular monomers that requires in the present claims, because the order of the particular monomer is controlled by the desired characteristics of the resulting block copolymer. The motivation is that it is within the skill of one in the art to use a method of producing a tapered block copolymer in Trepka's invention wherein the order of charging of the particular subsequent monomer(s) is controlled, and any addition monomer can be added for the purposes of obtaining the desired characteristics of the resulting block copolymer and since it requires only ordinary skill of the worker in the art.

II. Applicants' Response to the Rejection

Applicants respectfully submit that claims 1-17 would not have been obvious over Trepka.

(A) Claims 1-7

Claims 1-7 are directed to a process for the product of a transparent resinous copolymer. Claims 1 and 3 are independent claims.

As noted above, the Examiner states that the difference between the instant claims and Trepka is that the second step (b) of Applicants' claimed involves adding a conjugated diene B_1 to the product of step (a), whereas the second step of the Trepka method involves adding a second monovinylaromatic monomer S_2, instead of a conjugated diene, to the product of step (a). According to the Examiner, it would have been obvious to modify the order of adding monomers in a method for preparing a tapered block copolymer in Trepka's invention such that a conjugated diene monomer is added in the second step to the system instead of a monovinylaromatic monomer for making the same sequence charging of the particular monomers required in Applicants' claims because the order of the particular monomer is controlled by the desired characteristics of the resulting block copolymer.

Applicants respectfully submit that Trepka does not provide any motivation, reason or suggestion to substitute a conjugated diene for the second monovinylaromatic monomer in the second step of the method therein. For example, Trepka teaches that:

> [t]he unique polymodal tapered block character of the polymer and low blueness and good impact strength and/or ductility or articles made from the polymer or blends of the polymer of the first embodiment of this invention are produced by the ***unique sequence of an initial charge of monovinylaromatic monomer and initiator and monovinylaromatic monomer***, followed by a separate charge of a mixture of monovinylaromatic monomer and conjugated diene, and a subsequent coupling step. [emphasis added] (col. 5, lines 9-18).

Thus, "the initial charge of monovinylaromatic monomer and initiator and a subsequent addition of a second charge of initiator and monovinylaromatic monomer" constitutes a part of a "unique sequence" of monomer additions that lead to a polymer having a "unique polymodal tapered block character." Applicants submit that because Trepka teaches that the two successive additions of monovinylaromatic monomers are part of a "unique sequence", Trepka provides no motivation, reason or suggestion to use a conjugated diene in place of the second monovinylaromatic monomer in the second step of the Trepka method.

Trepka also does not teach or suggest step (c) of Applicants' claimed methods. In the method of instant claim 1, step (c) involves charging a multi-functional deactivation agent to kill a fraction of the living polymer species generated in step (b). In the method of instant claim 3, step (c) involves adding to the mixture (ii) a multi-functional deactivator agent (X) to partially kill the living chains present in the so-formed mixture (iii) to form at least the species $(S_1\text{-}B_1)X$. According to the instant specification at page 4, lines 3-18:

> ***[t]he present invention is predicated on the discovery by the present inventors*** that, for the production of transparent resinous conjugated diene/monovinyl-substituted aromatic block copolymers, ***it is of high interest to use the process which comprises a first partial killing of at least the living copolymeric species $R\text{-}S_1\text{-}B_1\text{-}M$ with a multi-functional deactivation*** where S_1 is a monovinyl-substituted aromatic homopolymer, B_1 is a conjugated diene homopolymer, M is an alkali metal and R an alkyl (RM being an initiator) and where said production comprises a second total deactivation of at least the living tapered block copolymeric species $R\text{-}S_1\text{-}B_1\text{-}B_2/S_2\text{-}M$ (obtained by adding a feed

> B_2/S_2 to the reaction medium) by a mono-functional deactivation agent (the terminating agent), the presence of at least two in situ produced polymeric species yielding a good combination of optical and mechanical properties with improved flow properties [emphasis added].

Thus, the partial killing of the copolymeric species R-S_1-B_1-M with a multiple deactivation, i.e., step (c) of Applicants' claimed methods, is part of the "discovery" made by the present inventors for making the transparent resinous conjugated diene/monovinyl-substituted aromatic block copolymers. The importance of step (c), as well as step (b), is illustrated in Comparative Example 3 set forth in the specification at pages 22-24. In Comparative Example 3, steps (2) and (3) of the claimed methods are omitted. The flexural modulus and tensile at break properties of the copolymer formed in Comparative Example 3 were significantly inferior to those of the copolymers formed in Examples 1 and 2, which used the methods of the present invention. According to the specification at page 24, lines 4-9:

> [a]lthough the copolymers of examples 2 and 3 have same styrene content, same random styrene content and similar melt flows, the injectability is poorer for copolymer of example 3. ***This illustrates that the intermediate deactivating step in the preparation of the copolymer dramatically improves the properties of the polymer.*** [emphasis added]

Thus, the intermediate deactivating step carried out in the third step of the claimed methods of this invention significantly affects the copolymer's properties.

In the Trepka method, a coupling agent (which can function as a deactivator) is added only at the end of the method. Trepka does not teach or suggest either the second step or the third step of Applicants' claimed methods and would not have rendered it obvious to add a deactivating agent to the product formed in the second step of Applicants' claimed methods.

Thus, for at least the foregoing reasons, Applicants submit that Trepka would not have rendered method claims 1-7 obvious.

(B) Claims 8

Claim 8 is directed to a polymer obtainable by the process of claim 1. As stated above, the second and third steps of the claimed process affect the properties of the polymer formed therefrom (see, e.g., Comparative Example 3). Trepka does not teach the second and third steps of Applicants' claimed processes. Thus, the polymer formed in Trepka is not the same as the polymer set forth in instant claim 8.

(C) Claims 9-17

Claims 9-15 are directed to a transparent resinous conjugated diene/vinyl aromatic block copolymer. Claims 9 and 11 are independent claims. Claim 16 is directed to a resinous blend comprising at least one transparent resinous copolymer of claim 9. Claim 17 is directed to a process for manufacturing molded objects comprising the step of injecting the transparent resinous copolymer of claim 9 or the blend of a resinous blend comprising at least one transparent resinous copolymer of claim 9.

Trepka does not teach or suggest either component (i) or component (ii) of the copolymers set forth in independent claims 9 and 11. Component (i) is formed in the first three steps of Applicants' claimed processes. As noted previously herein, Trepka does not teach or suggest the second and third steps of Applicants' claimed processes. Component (ii) is formed by the copolymerization of a conjugated diene B_2/monovinyl-substituted aromatic S_2 monomers mixture in the presence of the remaining living species $R-S_1-B_1-M$, i.e., component (i). Because Trepka does not teach the steps leading to the formation of component (i), Trepka does not teach component (ii), which is formed from component (i). Thus, for at least these reasons, Trepka does not teach or suggest the transparent resinous conjugated diene/vinyl aromatic block copolymers of claims 9-15.

Because Trepka does not teach or suggest the copolymer of claim 9, the reference also does not teach or suggest a resinous blend comprising such copolymer (claim 16) or a process of manufacturing molded objects comprising the step of injecting such copolymer or a resinous blend comprising such copolymer (claim 17).

Therefore, for at least the foregoing reasons, Applicants respectfully submit that claims 16 and 17 would not have been obvious over Trepka.

III. Conclusion

In view of the amendments and remarks herein, Applicants respectfully request that the rejection of claims 1-17 be withdrawn and that these claims be allowed.

If any fees or credits are due please charge any additional fees due in connection with this filing, such as fees under 37 C.F.R. §§ 1.16 or 1.17, to our Deposit Account No. 02-4300.

Respectfully Submitted,

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AMENDMENTS TO THE SPECIFICATION

Please amend the paragraph at page 1, lines 6-12 as follows:

> The present invention relates to transparent block copolymers and in particular to transparent block copolymers produced from ~~monovinyl substitued~~ monovinyl-substituted aromatic monomers and conjugated dienes. The present invention also relates to a process for producing transparent block copolymers and in particular for producing transparent block copolymers of ~~monovinyl substitued~~ monovinyl-substituted aromatic monomers and conjugated dienes.

Please amend the paragraph at page 3, lines 8-12 as follows:

> The present invention provides a novel transparent resinous block copolymer of ~~monovinyl substitued~~ monovinyl-substituted aromatic hydrocarbon and conjugated diene which exhibits a high processability and conjugated dienes which exhibits a high processability during transformation in articles with high impact resistance, high flexural modulus and high transparency.

Please amend the paragraph at page 3, lines 13-20 as follows:

> It is another object of this invention to provide a novel transparent resinous block copolymer of ~~monovinyl substitued~~ monovinyl-substituted aromatic hydrocarbon and conjugated dienes suitable for use in blends with polymers of styrene, said blends exhibiting high impact resistance, high flexural module, high transparency and high processability during transformation in articles.

Please amend the paragraph at page 4, lines 20-30 as follows:

> The vinyl-aromatic content, the molecular weights of the two major species as well as their relative proportions are controlled so that the final mechanical properties and the improved processability can be achieved. The relative proportion of the two major species is proportional to the molar ratio of the multifunctional deactivator agent to the active initiator corrected for the ~~stoechiometry~~ stoichiometry. As indicated above, the process of the invention is thus based in most part on the control of this ratio, which is selected so that, given the relative contents of the monomers, the final properties of the resinous copolymer can be achieved.

Please amend the paragraph at page 4, line 31 – page 5, line 10 as follows:

> Thus, if the first polymer species (S_1-B_1)X is, for example, a styrene-butadiene block copolymer having a high styrene content, for example greater than 50 wt%, and the second block polymer species having high styrene content, for example greater than 80 wt%, this can provide high transparency for the block copolymer in conjunction with high impact resistance. The provision of in situ generated first and second polymeric species provides a high processability polymer grade, which can readily flow in an extrusion line, injection machine, blown-film line or blow-molding machine. It should be noted that it is conceivable to carry out this process in multiple reactors followed by mixing the resulting polymer solutions.

Please amend the paragraph at page 8, line 31 – page 9, line 10 as follows:

> In accordance with a specific aspect of the invention, S_1 and S_2 are monovinyl-substituted aromatic homopolymer blocks having

molecular weights within the range of about 5000 Daltons to ~~20000~~ 20,000 Daltons for S_1 and about ~~50000~~ 50,000 Daltons to ~~150000~~ 150,000 Daltons for S_2. B_1 is a conjugated diene homopolymer block having a molecular weight within the range of about 3000 ~~daltons~~ Daltons to ~~10000~~ 10,000 Daltons. B_2/S_2 is a conjugated ~~diene/monovinyl-substitute~~ diene/monovinyl-substituted aromatic random copolymer block (tapered block) having a molecular weight within the range of about ~~10000~~ 10,000 Daltons to ~~100000~~ 100,000 Daltons. The molecular weight of S_2 is significantly greater than that of S_1, for example from a factor of 5 up to 10.

Please amend the paragraph at page 9, lines 11-16 as set forth below:

The copolymeric species (ii) obtained according to the process of the invention has a molecular weight generally ranging from about ~~100000~~ 100,000 Daltons to about ~~300000~~ 300,000 Daltons, preferably from about ~~140000~~ 140,000 Daltons to ~~200000~~ 200,000 Daltons, especially from about ~~150000~~ 150,000 Daltons to ~~180000~~ 180,000 Daltons.

Please amend the paragraph at page 10, lines 7-15 as set forth below:

The ~~monovinyl-substitued~~ monovinyl-substituted aromatic monomers which can be employed in the block copolymer of the present invention include, for example, styrene, alpha-methylstyrene, vinyltoluene, 4-n-propylstyrene, 4-cyclohexylstyrene, 4-decylstyrene, 2-ethyl-4-benzyl-styrene, 4-p-toluylstyrene, 4-(4-phenyl-m-butyl)styrene, vinyl-naphthalene and other styrenes which are substituted on the ring. Styrene, isoprene and 1,3-butadiene are the preferred monomers due to their availability and consistent good results.

Please amend the paragraph at page 10, lines 16-18 as follows:

> Conjugated dienes and ~~monovinyl-substitued~~ monovinyl-substituted aromatic monomers are, as usual in the art, preferably free of impurities which may act as scavengers in the reaction medium.

Please amend the paragraph at page 12, line 30 – page 13, line 4 as follows:

> Step (1) is charging solvent, (preferably with polar compounds, see below) and ~~monovinyl-substitued~~ monovinyl-substituted aromatic monomer referred to as S_1, in the reactor to form the first block species R-S_1-M in the presence of sufficient organo-alkali metal initiator RM to initiate the polymerization and achieve the molecular weight desired for. This molecular weight is controlled by in-line or laboratory Gel Permeation Chromatography (GPC).

Please amend the paragraph at page 13, lines 8-12 as follows:

> At the beginning of this step, the temperature of the ~~monovinyl-substitued~~ monovinyl-substituted aromatic monomer in the presence of the solvent and the organolithium initiator which is known as the initiation temperature (T_{init}) is preferably set below 60C, more preferably below 55C.

Please amend the paragraph at page 13, lines 18-25 as follows:

In order to increase the initiation and propagation rate, especially when using alkyllithium like ~~n-Butyllithium~~ n-butyllithium, small amount of polar compounds can be added, eventually in mixture with solvent to the reaction medium before adding the initiator. By modifying the polarity of the medium, one also affects the randomization of the ~~monovinyl-substitued~~ monovinyl-substituted aromatic monomer during the copolymerization of said monomer in mixture with the conjugated diene (see below).

Please amend the paragraph at page 14, lines 1-11 as set forth below:

> Step (3) is charging a multi-functional deactivation agent X after completion of step (2). This ~~desactivation~~ deactivation agent is an agent known in the art to be a coupling agent, but used here for a different purpose, which is partial killing or ~~desactivation~~ deactivation. In the following, it will be referred to as either the ~~desactivation~~ deactivation agent or the coupling agent (without making any difference). The r amount of said mult-functional deactivator is selected so as to be less than the ~~stoechiometric~~ stoichiometric amount relative to the initiator really used to start the polymerization and referred to as RM_a.

Please amend the paragraph at page 14, lines 12-13 as follows:

> One of the key aspects of the invention is the control of the respective amounts of initiator and ~~desactivating~~ deactivating agent.

Please amend the paragraph at page 14, lines 25-27 as follows:

> In the invention, the ratio ~~desactivating~~ deactivating agent X:initiator (e.g., RM_a) is comprised between ~~0,5 and 0,9~~ 0.5 and 0.9 of the ~~stoechiometry~~ stoichiometry, preferably between ~~0,6 and 0,8~~ 0.6 and 0.8.

Please amend the paragraph at page 16, lines 4-10 as follows:

> By a proper selection of the polar compound, or randomizer, it is possible to adjust the proportion of the random ~~monovinyl-substitued~~ monovinyl-substituted aromatic monomer dispersed in the conjugated diene phase. As these polar compounds also affect the 1,2 addition of the conjugated diene monomer and the resulting

vinyl character, it is possible to adjust the molecular structure of the B_1-B_2/S_2 part of the copolymer.

Please amend the paragraph at page 16, lines 11-15 as follows:

In one embodiment of this invention, it is feasible to add an additional amount of randomizer or polar compound or mixture thereof in order to increase the random part of the monovinyl-substitued monovinyl-substituted aromatic monomer and/or promote the 1,2 addition of the conjugated diene.

LISTING OF CLAIMS

Claim 1 (Currently Amended): A process for the production of a transparent resinous copolymer, the process comprising the sequential steps, in a reaction medium, of:

(a) charging in the presence of an initiator, a first monovinyl-substituted aromatic monomer and contacting it until all the monomer is polymerized;

(b) charging a conjugated diene and allowing the polymerization to occur;

(c) charging a multi-functional deactivation agent to kill a fraction of the living polymer species generated in step (b);

(d) charging a mixture of a second ~~monovinyl-substitued~~ monovinyl-substituted aromatic monomer and a second conjugated diene monomer and allowing polymerization to ~~occurs~~ occur in the presence of a random distribution agent until all the monomers are consumed; and

(e) recovering the polymer using a terminating agent.

Claim 2 (Original): The process of claim 1 carried out in the presence of a polar compound added in step (a).

Claim 3 (Currently Amended): A process for the production of a transparent resinous copolymer, the process comprising the sequential steps, in a reaction medium, of:

(a) polymerizing a monovinyl-substituted aromatic monomer (S_1) in a solvent in presence of a polar compound and a initiator (~~RM~~ RM_a) until essentially no unreacted ~~monovinyl-substitued~~ monovinyl-substituted aromatic monomer is left in the so-formed mixture (i) to form at least the species $R\text{-}S_1\text{-}M$;

(b) adding to said mixture (i) a conjugated diene (B_1) and allowing the polymerization to occur until essentially no conjugated diene is left in the so-formed mixture (ii) to form at least the species ~~R-S1-B_1-M~~ $R\text{-}S_1\text{-}B_1\text{-}M$;

(c) charging to said mixture (ii) a multi-functional deactivator agent (X) to partially kill the living chains present in the so-formed mixture (iii) to form at least the species (S_1-B_1)X;

(d) adding to said mixture (iii) a mixture of ~~monovinyl substitued~~ monovinyl-substituted aromatic monomer (S_2) and conjugated diene monomer (B_2) and allowing the copolymerization to occur until essentially no unreacted monomers are left in the so-formed (iv) mixture to form at least the species ~~R-S1-B_1-B_2/S_2-M~~ R-S_1-B_1-B_2/S_2-M; and

(e) recovering the so-formed species R-S_1-B_1-B_2/S_2-M (v) using a terminating agent.

Claim 4 (Currently Amended): The process of claim 3, ~~in which the ratio~~ wherein the process uses a X:RM_a stoichiometric ratio of ~~is comprised~~ between ~~0,5 and 0,9~~ 0.5:1 and 0.9:1 ~~of the stoechiometry~~.

Claim 5 (Currently Amended): The process of claim 3, ~~in which~~ wherein the X:RM_a stoichiometric ratio ~~X Rma~~ is ~~comprised~~ between ~~0,6 and 0,8~~ 0.6:1 and 0.8:1 ~~of the stoechiometry~~.

Claim 6 (Previously Presented): The process of claim 1, wherein the proportions by weight of the first vinyl aromatic monomer/first conjugated diene monomer/second vinyl aromatic monomer/second conjugated diene monomer are, in percent based on the total amount of monomers, 5-30/2-20/50-80/5-25, inclusive.

Claim 7 (Previously Presented): The process of claim 1, wherein the proportions by weight of the first vinyl aromatic monomer/first conjugated diene monomer/second vinyl aromatic monomer/second conjugated diene monomer are, in percent based on the total amount of monomers, 10-25/5-15/55-70/7-20, inclusive.

Claim 8 (Previously Presented): The polymer obtainable by the process of claim 1.

Claim 9 (Currently Amended): A transparent resinous conjugated diene/vinyl aromatic block copolymer comprising:

(i) a first conjugated diene/monovinyl-substituted aromatic block copolymer, resulting from the partial deactivation by a multi-functional agent of the living species ~~R-S1-B1-M~~ $R\text{-}S_1\text{-}B_1\text{-}M$ wherein ~~S1~~ S_1 is a monovinyl-substituted vinyl aromatic block, ~~B1~~ B_1 is a conjugated diene block, RM being an initiator wherein the living species ~~R-S1-B1-M~~ $R\text{-}S_1\text{-}B_1\text{-}M$ has a molecular weight comprised between ~~10.000~~ 10,000 and ~~50.000~~ 50,000 Daltons and a vinyl aromatic content comprised between 40 and 90% by weight; and

(ii) a second conjugated diene/monovinyl-substituted aromatic block copolymer, resulting from the copolymerisation of a conjugated diene B_2/ ~~mono-vinyl-substitued~~ monovinyl-substituted aromatic S_2 monomers mixture in presence of the remaining living species $R\text{-}S_1\text{-}B_1\text{-}M$ to form the species $R\text{-}S_1\text{-}B_1\text{-}B_2/S_2\text{-}M$ wherein B_2/S_2 is a tapered block, wherein said species $R\text{-}S_1\text{-}B_1\text{-}B_2/S_2\text{-}M$ has a molecular weight comprised between ~~90.000~~ 90,000 Daltons and ~~300.00~~ 300,000 Daltons and a vinyl aromatic content comprised between 60% and 85% by weight.

Claim 10 (Currently Amended): The transparent resinous copolymer of claim ~~8~~ 9, wherein the resinous copolymer comprises from 5 to 40 wt% of said first conjugated diene/vinyl aromatic block copolymer.

Claim 11 (Currently Amended): A transparent resinous conjugated diene/vinyl aromatic block copolymer comprising:

(i) a first conjugated diene/vinyl aromatic block copolymer, having a radical structure with chains having a molecular weight comprised between 10,000 and 50,000 Daltons and a vinyl aromatic content comprised between 40 and 90% by weight; and

(ii) a second conjugated diene/vinyl aromatic block copolymer, having a tapered structure with chains having a molecular weight comprised between 90,000 and 300,000 ~~daltons~~ Daltons and a vinyl aromatic content comprised between 75% and 90% by weight;

the resinous copolymer comprises from 5 to 40wt% of said first blocks; and the total vinyl aromatic content of the resinous copolymer being comprised between 70 and 85% by weight.

Claim 12 (Currently Amended): The transparent resinous copolymer of claim ~~8~~ 9, wherein the structure of the first copolymer is of the type (S, -B,) X where X has n functions where n is from 2 to 8.

Claim 13 (Currently Amended): The transparent resinous copolymer of claim ~~8~~ 9, wherein the total vinyl aromatic content is comprised between 75 and 82% by weight.

Claim 14 (Currently Amended): The transparent resinous copolymer of claim ~~8~~ 9, wherein the first conjugated diene/monovinyl-substituted aromatic block has a vinyl aromatic content comprised between 40 and 65% ~~byweight~~ by weight.

Claim 15 (Currently Amended): The transparent resinous copolymer of claim 9, wherein the molecular weight ~~he~~ of the second copolymer chain is comprised between 150,000 and 180,000 ~~daltons~~ Daltons.

Claim 16 (Currently Amended): A resinous blend comprising at least one transparent resinous copolymer of claim ~~8~~ 9.

Claim 17 (Currently Amended): A process for manufacturing molded objects comprising the step of injecting the transparent resinous copolymer of claim ~~8~~ 9 or the blend of a resinous blend comprising at least one transparent resinous copolymer of claim ~~8~~ 9.